JOINT MANAGEMENT PLAN REVIEW
ISSUE BACKGROUND: Water Quality--Desalination

Issue Description:
Desalination is the process by which salts and other chemicals are removed from salt or brackish water. It is also known as Desalinization or Desalting or commonly referred to as "desal". As traditional sources of fresh water continue to be depleted and degraded, society is increasingly looking toward desalination as an option for obtaining water for both private, and municipal freshwater supply. In the past it has not been used extensively, primarily because the cost of the product water has been so much higher than that from conventional sources. With more efficient desalting technologies being able to produce the water cheaper, in conjunction with escalating costs of obtaining fresh water from conventional sources, desalination is starting to look more and more attractive as an option to many proponents.

Desalination refers to any technology that removes salt from water and includes a wide range of technologies that fall into two main categories, with many variations on each. Distillation processes involve heating the intake water to produce steam, which is then condensed to produce water with a very low salt concentration. Reverse Osmosis (RO) refers to the processes in which intake water is pressurized and forced through a semi-permeable membrane. The water passes through the membrane, but the salt molecules do not. With either technology, after the desalting process both fresh water, and concentrated saline brine are produced. RO is the predominant technology being used and proposed in the Sanctuary region.

Three desalination facilities currently operate within the boundaries of the Sanctuary; however there has recently been an increase in interest for both private and public desalination plants. Approximately ten facilities have recently been proposed. Rather than utilizing a cumulative regional planning approach, each plant has been conceived and designed as a separate project. Due to population growth in the area, continuing shortages and degradation of conventional water supplies, and advances in desalination technology, the trend will likely continue. Desalination plants have the potential to negatively impact the marine environment through the introduction of brine waste effluent and other substances to Sanctuary waters. Additionally, the construction of desalination facilities and associated pipelines often causes alteration of the seabed. The Sanctuary will work with this joint management plan review desalination working group to develop a regional approach to address desalination, aimed at reducing impacts to marine resources in the Sanctuary through consideration of facility siting issues, on-site mitigation measures, modeling and monitoring, and outreach and information exchange.

Potential impacts of Desalination:
Desalination impacts vary widely and are typically site specific. The severity of the impacts in large part depends on overall plant design and operation, methods used for effluent disposal and specific physical and biological conditions in the vicinity of the plant. While desalination can

cause significant adverse environmental effects, there are effective mitigation measures that can be taken to reduce impacts. Furthermore, it is important to consider that all other methods of obtaining municipal fresh water also involve major environmental impacts. This is especially the case when salt-water intrusion, or damage to anadromous or endangered species habitat caused by over-drafting of water from rivers and streams, is an issue.

Construction of a desalination facility, especially if new pipeline construction is involved, can have significant environmental impacts, including disturbances to seafloor, surf zone, and dune ecology. By using existing pipeline structures or alternative technologies such as injection wells or percolation galleries, benthic impacts can be minimized or eliminated altogether.

Among the various impacts of desalination however, the Sanctuary is most concerned with the discharge of the hyper-saline water that remains as a byproduct from the desalination process,. This saline brine effluent is generally about twice as salty as the ambient seawater, however this varies quite a bit depending upon the specific technology being used, and can range anywhere between 46 and 80 parts per thousand (ppt) (typical salinity in the region is around 33ppt). This effluent is denser than seawater and tends to sink to bottom where it becomes concentrated. Both high levels of concentration, and fluctuations in salinity levels may kill sensitive organisms near the outfall. While tolerances vary quite a bit among organisms, more research is needed to determine the extent impacts for various species found in the MBNMS. The impacts of the brine effluent vary widely as a function of the location of the outfall. Impacts are generally more severe in rocky substrate than sandy seafloor habitats. Other issues associated with the discharge are: increased turbidity; and concentration of organic substances and metals that are contained in the feed waters. Additional impacts specific to distillation facilities include concentration of metals picked up through contact with the plant components, thermal pollution and decreased oxygen levels.

While if unmitigated, the impacts caused by brine effluent can be severe, there are many existing measures that can be taken, which have been proven to minimize these impacts. Certain technologies such as injection wells or percolation galleries minimize the impact from the saline brine discharge due to adequate mixing of brine and ambient seawater. Diffuser valves of appropriate size and number, used with open ocean disposal structures also can facilitate mixing of desalination discharge with ambient seawater. Certain plants, such as the one located in the City of Marina, and the proposed Sand City facility utilize brackish groundwater as a feed water source; this results in a brine reject that is lower in salinity than typical brine effluent from similar facilities that desalt seawater.

Intake of water directly from the ocean usually results in loss of marine species as a result of impingement and entrainment. Impingement is when organisms collide with screens at the intake, and entrainment is when species are taken into the plant with the feed water and are killed during plant processes. Impingement and entrainment impacts can be mitigated by the use of certain designs and technologies. Properly engineered intake structures can reduce the potential for entrainment and impingement, and in certain cases the need for chemicals. Structures such as onshore intake wells or infiltration galleries have been proven highly effective. Appropriately

sized screens at the intake, as well as low velocity water flow are potential mitigation measures for open water intake structures.

Clearly the most contentious and controversial issue surrounding desalination is its potential to induce community growth. Along most of the California coast, fresh water supply is the limiting factor for community growth. With the addition of an unlimited source of freshwater, growth can be allowed to occur. While this issue is not addressed directly by Sanctuary regulations, it is of major concern. Increased development of the coastline adjacent to the MBNMS, could lead to degradation of water quality, and many other challenges to the protection of Sanctuary resources. It is up to local jurisdictions to ensure that a proliferation of desalination facilities does not lead to unsustainable community growth, through responsible planning, and limitations in plant capacities. This issue is addressed by many other agencies including the California Coastal Commission, and local jurisdictions.

Desalination in the Sanctuary:
The Sanctuary is concerned with desalination, because it has the potential to negatively impact the marine environment through the introduction of brine waste effluent and other substances to Sanctuary waters. Additionally, the construction of desalination facilities and associated pipelines often causes alteration of the seabed. Three of the Sanctuary's regulations relate directly to desalination. The first involves a prohibition on discharging or depositing any material from within Sanctuary boundaries. Since the brine effluent, and in some cases other materials, are usually disposed of in ocean waters, this activity requires Sanctuary authorization of Regional Water Quality Control Board (RWQCB) permits. The second Sanctuary regulation pertains to discharging materials outside of the boundaries, which subsequently enter Sanctuary waters and negatively impact MBNMS resources. As with the previous regulation, Sanctuary approval via authorization of the RWQCB permit is required. The third relevant regulation involves a prohibition on activities that cause alteration of the seabed. Thus installation of certain desalination facility structures such as an intake/outfall pipeline on or beneath the ocean floor will also require Sanctuary authorization.

Three small desalination plants currently operate in the Sanctuary:

- *Duke power plant,* in Moss Landing contains a seawater distillation plant that produces a little less than 1/2 million gallons per day (MGD), for use in its boiler tubes for the power production process. This facility uses power plant cooling water as the source for the desalination feed water, and brine effluent discharge. Due to the large volume of water being discharged by the plant, the brine effluent is diluted and impacts from the salinity are eliminated.

- A small plant, operated by the *Marina Coast Water District* in the City of Marina with the capacity of .45 MGD, currently supplies about 13% of the city's annual municipal water consumption. This plant uses a beach well for intake water, and an injection well for discharging brine effluent. This facility was originally built in 1996, and is currently being renovated, with new technologies that will greatly increase its efficiency.

- The *Monterey Bay Aquarium* operates a very small facility that provides about 40,000 gallons per day of water used for maintenance purposes such as flushing the toilets. The saline brine discharge is blended with, and effectively diluted by the exhibit water outfall.

There are currently only three facilities in operation within the boundaries of the Sanctuary however there has recently been an increase in proposals for both private and public desalination plants. There are approximately ten additional facilities in the Sanctuary region that are in some stage of initial consideration or planning. These range from small, less than 50,000 GPD private facilities such as the proposed RO plant for the Ocean View Plaza to be built on cannery row in Monterey, to larger multi-city regional projects like the ones the City of Santa Cruz and Monterey Peninsula Water Management District are currently investigating. There are also several proposals for small to medium size projects to serve a single city, such as the proposed plants in Cambria, or Sand City. Due to population growth in the area, continuing shortages and degradation of conventional water supplies, and advances in desalination technology, the trend will likely continue.

In response to these issues, the Sanctuary recently initiated a joint effort with the California Coastal Commission and the Central Coast Regional Water Quality Control Board, to evaluate the emerging issue of desalination, and develop a series of regional guidelines and recommendations, in order to develop a more comprehensive approach. Additionally, the Coastal Commission and MBNMS are in the process of updating and expanding a report that was originally published by the commission in 1993, titled *Seawater Desalination in California.*

Working Group Objectives:
This working group shall work to reach consensus in developing a recommendation to the MBNMS Advisory Council for a long-term strategy to address the issue of desalination within the Sanctuary. MBNMS and the Coastal Commission have made significant progress in assessing future needs in addressing the issue, and developing an outline of categories to be considered for a regional approach to desalination. MBNMS and the Coastal Commission identified the following series of objectives, potential actions, and information needs, which will serve as a starting point for this Joint Management Plan Review desalination working group to review.

Desalination Facility Siting Issues: Environmental impacts in large part depend on specific physical and biological conditions in the vicinity of the outfall. Through proper siting of facilities and intake/outfall structures, impacts can be minimized. Potential issues include:

- Intake and outfall siting and design to avoid sensitive locations such as kelp beds, rocky habitats etc.
- Mixing of brine effluent with power plant cooling water or sewage treatment plant discharges
- Encouraging regional facilities rather than proliferation of small plants
- Using full capacity of existing desalination facilities before constructing new plants

- Outfall siting and design to ensure an adequate mixing rate and dilution volume to minimize adverse impacts, preferably to the open ocean rather than to areas with limited water circulation like bays or estuaries
- Use of existing pipelines, rather than construction of new ones, which may cause seabed alteration
- Identification of preferred conditions and habitats types that are the most resilient to the impacts of brine effluent, as well as sensitive habitats where brine effluent disposal should be avoided

On-site mitigation measures: Specific engineering and design aspects of desalination plants are a major determinant of the severity of the impacts. There is an increasingly wide range of different technologies available, including many promising new advances in intake design, pretreatment, reverse osmosis, and brine disposal technology. The working group shall investigate the range of alternatives available, and identify preferred types of alternatives, which reduce or eliminate impacts to marine resources. Items for consideration may include:

- Use of pretreatment techniques that minimize or eliminate the need for hazardous chemicals, e.g. beach wells, infiltration galleries, pre-filtration membranes, ozone treatment
- Use of pipes that minimize the corrosion of hazardous substances (polyethylene or titanium is preferable to copper nickel)
- Removal of hazardous constituents in the brine prior to discharge
- Low flow velocities in the intake channels to minimize entrainment and impingement of marine species.
- Special intake design to reduce the potential for entrainment and impingement e.g. screens, onshore intake wells or infiltration galleries
- Evaluation of new and emerging desalination technologies

Modeling and Monitoring: There is a need for a comprehensive modeling and monitoring program, to determine expected impacts, short-term impacts and long term impacts. There is a lack of adequate data about desalination-based impacts. The working group will outline a comprehensive monitoring program, which should include:

- Pre-operational monitoring to include sampling of water column, sediments, and inventory of marine organisms in the vicinity of the outfall.
- Required pilot studies to provide information on expected brine composition, volumes, dilution, and dispersion rates of the brine in the ocean.
- Monitoring to determine currents, tides, water depth and similar parameters of receiving waters.
- Required toxicity testing early in the process (at CEQA stage)
- Laboratory studies to determine properties of combined discharges (cooling water or sewage), and their effects and toxicity on local species.

- Post operational monitoring to include sampling of water column, sediments, and inventory of marine organisms in the vicinity of the outfall, to be compared with pre-operational monitoring results.
- Post operational monitoring of salinity in discharge site as indicator for plume spreading and dispersal, to be compared with expected results from plume modeling.
- Post operational monitoring of oxygen levels, turbidity, heavy metals or other chemical concentrations, with regard to water quality standards.
- Post operational sampling of sediments for heavy metals to monitor possible accumulation. (possible bio-monitoring to sample tissues for heavy metals).
- Monitoring of long term impacts of discharge (e.g. potential changes in species composition etc.)

Outreach and Information Exchange: Once finalized, the Sanctuary will conduct extensive outreach on the guidelines and recommendations developed by this working group.

- The action plan will include strategies for education and outreach to agencies, desalination plant proponents, and other interested parties about the guidelines as well as relevant regulations.

- The plan will also outline strategies to track new desalination proposals, so we can enter into discussion with agencies and desalination plant proponents early on in the process.